

CW Sentry

Installed Chemical Agent Detector for Building Security

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CW Sentry: Installed Chemical Agent Detector for Building Security

Security Requirement:

It was vividly demonstrated in Japan that organized, well funded terrorist groups are fully capable of delivering and releasing lethal quantities of chemical agents at sites of their choice. As sites for such terrorist attacks will almost certainly be locations with relatively uncontrolled access by large numbers of people, it may be extremely difficult to detect carefully packaged and concealed agent prior to release. Even in the absence of prior detection, the security of a site or facility, and the safety of its people, will be critically dependent on the rapid detection of any agent released.

Whatever the facility or building selected by terrorists for an attack - a subway platform, building lobby, or entrance to a sports arena - the spread of the deadly gas, and thus its lethal effect, will largely be controlled by movement of air within the structure, i.e. by the ventilation system.

Safety and security of the building, therefore, requires that an Installed Chemical Agent Detection System must:

- be capable of rapid, highly reliable detection and alarm
- be capable of continuous, unattended operation
- have very low probability of false alarms
- be strategically located to provide the earliest possible warning
- be interfaced with HVAC systems for automatic shutdown
- provide complete building coverage

CW Sentry

Design Concept

The CW Sentry was designed to include the same solid-state sensor "engine" as used in the successful SAW Miniature Chemical Agent Detector (SAW MINICAD). The heart of the detector module is an array of surface acoustic wave devices optimized for the simultaneous detection of both nerve and blister agents at low concentrations. The sensors respond within 60 seconds to a vapor challenge and, as they are reversible, can provide an ALL CLEAR as well.

The CW Sentry package, as shown in Figure 1, is both compact and rugged, and can be easily installed for fixed site operation. The instrument was designed with an automatic switch closure for easy interface with an HVAC system and/or an alarm panel. As the SAW sentry must operate automatically, continuously and reliably over extended periods of time, it was designed with many self-diagnostic and back-up features. It has an onboard computer that can be programmed to notify maintenance personnel when service is required. It has a modular design in which each

component can be easily and quickly replaced in order to minimize maintenance. Another design objective was to keep the cost as low as possible.

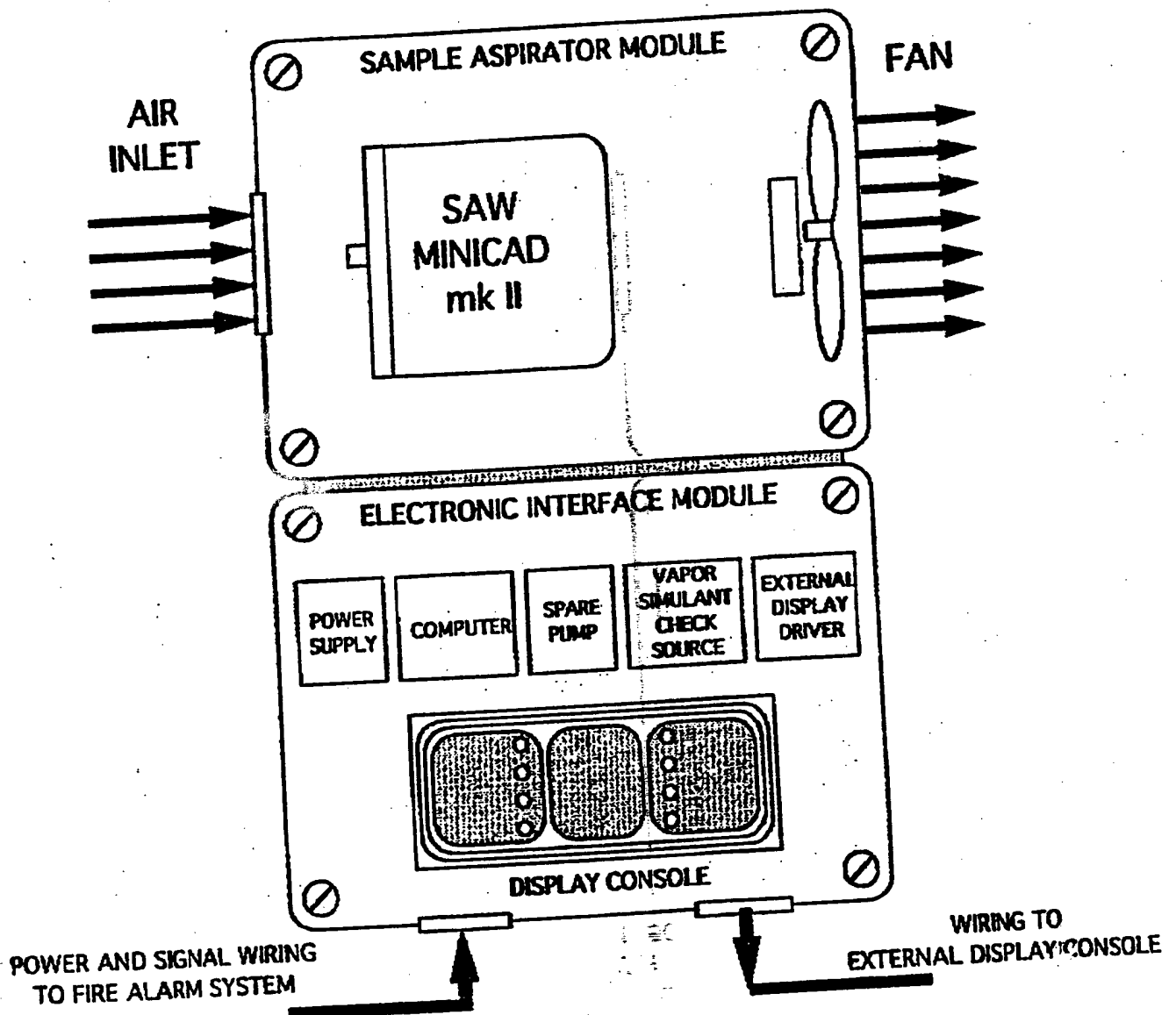


Figure 1. Schematic Diagram of CW Sentry Installed Chemical Agent Detector

Key Design Features

One of the features of the CW Sentry design is that it has a built-in air pump capable of pulling samples from locations up to 25 feet away. The Sentry can sample from four locations simultaneously and alarm within 60 seconds. For ease of installation and maintenance, the system was designed to operate at standard 24 volt DC fire alarm power, thus it can interface easily with remote monitoring consoles or other alarm panels. It is, in fact, designed to interface readily with standard fire alarm systems via a relay switch closure. Another key feature is the inclusion of an onboard vapor check source. This is one of self diagnostic features of the instrument that permits it to routinely determine that the sensors and identification algorithm are functioning properly and providing the required detection capability.

The CW Sentry also was designed with the option for remote control and alarm via an RS 232 serial data port. Remote console alarm panels can be installed in critical or highly sensitive areas such as VIP offices, conference rooms or an auditorium where rapid evacuation might be desired. The overall system was designed for easy installation and operation with little required training.

SAW Sensor Module

The SAW sensor module in the CW Sentry has two active surface acoustic wave (SAW) resonator devices for detection and a third for reference purposes. One active resonator has a coating selective for the nerve agents (GD, GB, GA) and the other a coating selective for mustard (HD). A typical device is shown below in Figure 2.

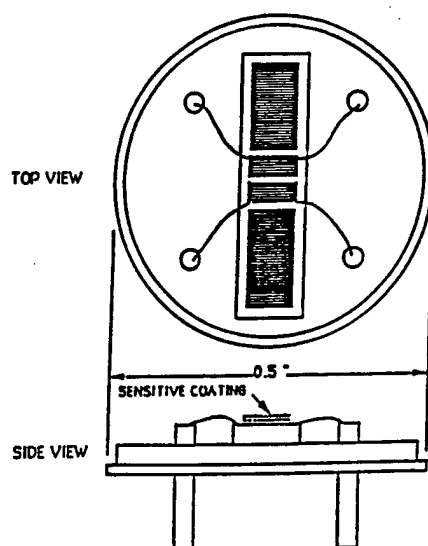


Figure 2. SAW Resonator Device used in CW Sentry Chemical Agent Detector

Identification of the agents is made by a computer controlled algorithm that analyzes the vapor response of the sensors. Typical sensor array response to a challenge of 1 ppm GA is shown in Figure 3. The algorithm measures and analyzes such features as time response, relative peak heights, rate of rise, and other peak features. The computer then compares the measured features with data stored in memory. Based on the comparison, the computer will decide whether or not the detected vapor is a chemical agent and its relative concentration. Before and after each run a baseline signal is determined.

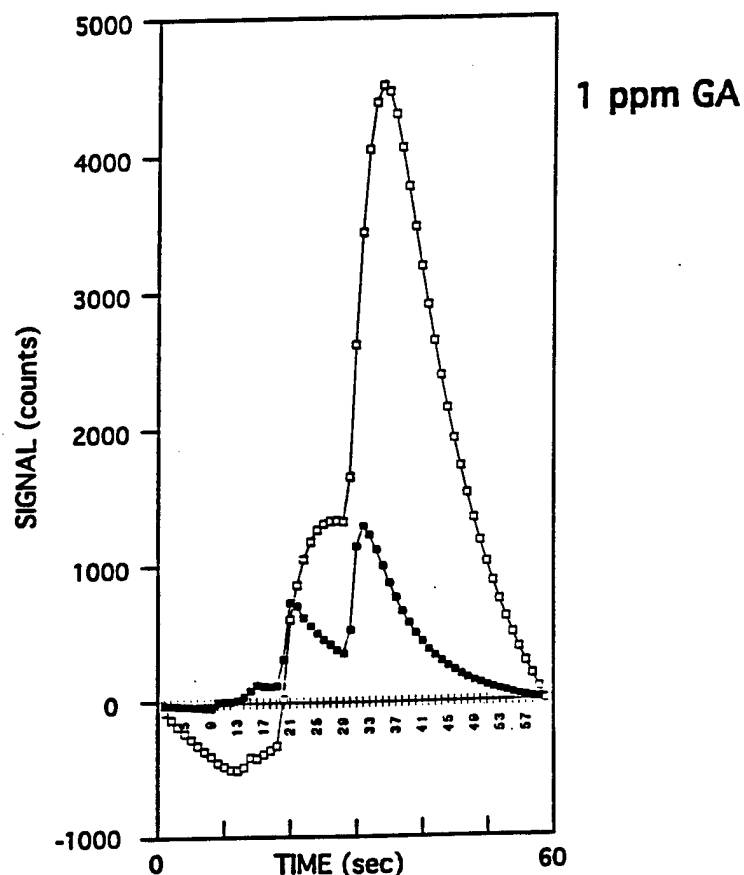


Figure 3. SAW Sensor Response to 1 ppm GA

The SAW sensor module as used in the SAW MINICAD and the CW Sentry has been extensively tested with both nerve agents and HD. The test results, shown in the accompanying Figure 4, were conducted at GEOMET Technologies, Inc. and were verified by MINICAMS gas chromatographic analysis. Four different MINICAD instruments were tested with GA, GB, GD, and HD at concentrations close to the desired instrument alarm levels. These levels are well above the actual instrument detection limits, which greatly decreases the likelihood of either a false negative or a false positive readings. Each of the four MINICAD instruments was exposed to each vapor a total of 10 times, and in each case the instrument alarmed as required. No false negatives were observed at any time.

		MINICAD SERIAL NO. 05960101		MINICAD SERIAL NO. 05960102		MINICAD SERIAL NO. 05960103		MINICAD SERIAL NO. 05960104	
AGENT	CONC. mg/m ³	NUMBER OF TESTS	NUMBER OF ALARMS	NUMBER OF TESTS	NUMBER OF ALARMS	NUMBER OF TESTS	NUMBER OF ALARMS	NUMBER OF TESTS	NUMBER OF ALARMS
GA	0.22	10	10	10	10	10	10	10	10
GB	0.60	10	10	10	10	10	10	10	10
GD	0.12	10	10	10	10	10	10	10	10
HD	1.20	10	10	10	10	-	-	-	-

* CW agent exposure testing conducted at GEOMET Technologies, Inc., Germantown, MD on January 3-5, 1996.

** All CW agent vapor concentrations verified by MINICAMS gas chromatographic analysis.

Figure 4. SAW Sensor Performance With CW Agents

Several companion studies have also been made of the response of the SAW sensor modules to potential interferent vapors. The test summarized in Figure 5 was one in which the concentrations of the potential interferents were determined. In these tests nine common interferent vapors were used, including, alcohols, gasoline vapors, a chlorinated solvent, water and an alkane, at the concentrations noted. In ten separate tests with each vapor no false alarms were observed. In more severe tests, in which vapors near their saturation concentrations were used, SAW MINICADS were exposed to nearly 100 different chemical vapors with excellent interference rejection. Interference was only observed for a few compounds, and then only at concentrations many thousands of times greater than the agent alarm values.

POTENTIAL VAPOR INTERFERENT	CONC. mg/m ³	NUMBER OF TESTS	NUMBER OF ALARMS
ISOPROPANOL	1000	10	0
METHANOL	507 ppmv	10	0
BTEX	10 ppmv	10	0
GASOLINE	600	10	0
BLEACH	1000	10	0
DICHLOROETHANE	1000	10	0
N-HEXANE	20 ppmv	10	0
WATER	(95%RH)	10	0

Figure 5. Interference Rejection by SAW Sensors

CW Sentry Specifications

The specifications of the CW Sentry are summarized in the following table:

CW SENTRY SPECIFICATIONS	
Weight:	6 pounds
Size:	4" x 6.25" x 9.5"
Enclosure:	Die-Cast Aluminum
Sensor System:	Surface Acoustic Wave Microsensors
Alarm Thresholds:	0.1 mg/m ³ GD 0.2 mg/m ³ GA 0.5 mg/m ³ GB 1.0 mg/m ³ HD
Response Time:	60 Seconds
Maintenance Interval:	5,000 hours
Power Required:	24 Volts DC @ 3A
Alarms:	(Four, Normally Open Switch Closure) 1 - Nerve Agent 2 - Blister Agent 3 - High Concentration 4 - System Fault
Data Output:	(Optional RS232C serial ASCII)
Operating Temp:	+5°C to +45°C
Humidity:	0% to 95% RH, non-condensing
Warranty:	One year or 5,000 hour of use (parts and labor)

Technical Approach for CW Sentry Implementation

Prior to installation of a SAW Sentry Installed Chemical Agent Detector, a careful assessment should be made of the chemical threat vulnerability of the selected facility. This would include an assessment of both internal and external factors such as concentration and movement of people, points of ingress and egress, location external air intakes, actual or potential crowd control points, and the many other factors that contribute to a facilities vulnerability to a chemical attack.

Special attention should be given to surveying the engineering facilities of the building, which would include review of appropriate drawings and discussions with facility management and engineers. It will be necessary to determine whether that the CW Sentry alarm system can be readily interfaced with existing HVAC fans and shutters so as to quickly shut down air movement within the facility in the event of a chemical attack, or if some modification will be needed. A review of the current fire alarm, or other special alarm systems and alarm consoles will also be required.

Based on the results and analysis of the facility surveys, a decision can be made as to where the CW Sentry units should be installed and how best to interface the units with existing facility equipment. Installation and testing of the CW Sentry could then proceed, including training of building engineering and security personnel on the use and maintenance of the system.

Summary of CW Sentry Features

Security Requirements

- **Rapid, Reliable Detection and Alarm**
- **Continuous, Unattended Operation**
- **Very Low False Alarm Rate**
- **Strategically Located Installation**
- **Automatic Shutdown of HVAC System**
- **Complete Building Coverage**

"CW Sentry" Design Concept

- **Solid-State SAW Vapor Sensor**
- **Simultaneous Detection of Nerve/Blister Agents**
- **Rapid and Reversible Detection**
- **Fully Automatic Operation and Reporting**
- **Compact, Durable, Low Maintenance**
- **Design for Fixed Installation Operation**
- **Compatible with Existing Fire Alarm Systems**

"CW Sentry" Key Features

- **Modular Design for Ease of Maintenance**
- **Built-in Air Pump**
 - **Adjustable**
 - **Sample 4 Locations up to 25 feet away**
- **On-Board Vapor Check Source**
- **Optional Remote Console Alarm Panel**
- **Self-Diagnosis to Detect Component Failure**
- **Interfaces with 24 VDC Fire Alarm Systems**

Technical Approach to Implementation

- **Assessment of Facility Chemical Vulnerability**
 - External
 - Internal
- **Survey of Building Engineering Facilities**
 - Drawings (Air Ducts, Fans, Shutters, etc.)
 - Discuss with Bldg. Management and Engineers
- **Select Location for Installation**
- **Install and Test CW Sentry**
- **Train Operations and Security Personnel**